IMPROVED HAMMER FOR A PIEZOELECTRIC ACTUATOR AND METHOD FOR PRODUCING SAME

BACKGROUND OF THE INVENTION

The present invention relates to a unique hammer used in piezoelectric actuators. Specifically the present invention provides a hammer body with integral outwardly extending hammer arms and a method for producing the same.

Existing hammers as used in piezoelectric actuators are composed of two separate component parts--a hammer body and a hammer pin. To date there has not been a hammer in one unit, i.e., the hammer body and pin molded together, by die cast molding, nor has there been a hammer with a hole through the hammer body by die cast molding. The technical problems of molding such a small piece have not been overcome.

Presently, assembly of the hammer pin into the hammer body necessitates drilling a hole through the hammer body. The drilling of such a small hole through the hammer body which is also miniature in size is very difficult. For best performance of the hammer, the hammer pin must be fixed at the center point of the hammer body and in an absolutely balanced, horizontal and symmetric manner. This is very difficult to achieve for technical reasons during assembly of the hammer pin into the hammer body.

In the present invention, the hammer still consists of 2 parts. Yet, it is not necessary to drill a hole through the hammer body. Furthermore, the center point of the hammer body and the balance, horizontality and symmetricalness of the hammer arms is guaranteed in the

process of the present invention. The performance of the finished product using this newly invented hammer is therefore enhanced.

SUMMARY OF THE INVENTION

The present invention is a two-part hammer for a piezoelectric actuator wherein the horizontal hammer arms are integrally molded into the hammer ring member. A hammer body member having a vertically extending axle supports and retains the ring member by extending through a central opening in the ring.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates a cross-sectional view of a prior art hammer within a piezoelectric actuator.

Fig. 2A illustrates an exploded perspective view of a first prior art hammer.

Fig. 2B shows a side elevation view of the first prior art hammer of Fig. 2A.

Fig. 2C illustrates an exploded perspective view of a second prior art hammer.

Fig. 2D shows a side elevation view of the second prior art hammer of Fig. 2C.

Fig. 3A illustrates an exploded perspective view of the hammer of the present invention.

Fig. 3B shows a side elevation view of the hammer of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 illustrates in a cross-sectional view of a prior art hammer 11A within a piezoelectric actuator. The operation of such devices is well known in the art. The actuator operates by the collision of the hammer 11A with other parts of the actuator to generate an

electric charge. Any deviation in the balanced, symmetrical construction of the hammer 11A will affect the stability of the emission of the electric charge from the actuator.

Figs. 2A-2D also illustrate prior art hammers. Fig. 2A is an exploded view of the two-part hammer 11. It has a hammer body member 12 and a hammer pin 14. A hole 16 must be drilled through the body 12 to accept the pin 14. The drilling is done after the body has been molded. Pin end 18 is pressed into the hole 16 and must be exactly in the center of the body 12 to be absolutely balanced and horizontal with the extended arms 22 and 24 perfectly symmetrical.

Another prior art hammer 11A is shown in Figs. 2C and 2D. Again, pin 14A must be pressed into drilled hole 16A with the arms 22A and 24 perfectly symmetrical, balanced, and horizontal within the body 12A.

The present invention is shown in Figs. 3A and 3B. Hammer 11C has a guaranteed center point with perfect balance, horizontal arms, and symmetric arms because the arms 22C and 24C are formed by unitary molding. The arms are formed in the molding process and are, therefore, integral to the ring body 30. The hammer arms are not formed by a pin passing through a delicately drilled hole as is known in the prior art. Hammer ring body 30, made of metallic or non-metallic materials, such as plastic, is a generally cylindrical tube with a vertically extending, central opening 34 with perpendicularly extending arms 22C and 24C. By forming the arms in the mold improved symmetry and balance of the hammer is achieved.

The hammer 11C is assembled by placing ring 30 over hammer body member 40, which is made of metal. Hammer body member 40 has a cylindrical base portion 42 with

a shoulder 44. Extending upwardly from the center of the base portion 42 is an elongated cylindrical axle member 46. When assembled, the underside 36 of the ring 30 is pressed against the shoulder 44 of the body member 40.

The outer surface 48 of the elongated axle 46 may be fixed or fitted tightly against the inner surface 38 of the ring 30 by various means. Depending upon the composition of the ring 30, there may be a certain degree of elasticity of ring 30, the diameter of the inner hole 34, thus, may be slightly less than the diameter of the elongated axle 46 (the axle having a diameter the same as or slightly greater than the hole). Alternatively, the inner surface 38 may be provided with protruding vertical strips 50 which when the ring 30 is wholly squeezed onto the elongated axle 46 will fit tightly against the inner surface 38 and the strips 50 to hold the ring 30 on the body member 40. Thus, an improved hammer is produced.

Although the invention has been described with reference to a specific embodiment, this description is not meant to be construed in a limiting sense. On the contrary, various modifications of the disclosed embodiments will become apparent to those skilled in the art upon reference to the description of the invention. It is therefore contemplated that the appended claims will cover such modifications, alternatives, and equivalents that fall within the true spirit and scope of the invention.